system, the question is: are changes in the state of the system associated with a change in the causality and how can this be detected? The answer is obtained by comparing the marginal allocation results for these cases with allocation on the mass basis with disaggregation. It was demonstrated above that physical causality is represented by mass when the system is disaggregated, with the allocated burdens the same as those obtained by marginal allocation. However, analysis of Cases 3 to 6 demonstrates that the same causality principle is no longer valid when the state of the system is defined by a mixture of process- and product-related parameters; causality is now too complex to be represented by a simple physical quantity, such as mass.

3 Conclusions

Because of the complex interactions among different parts of the product system, the kind of causality governing system behaviour and the resulting allocation coefficients cannot be identified without whole system modelling. The allocated burdens depend on the state of the system, which in turn depends on which constraints are active. As shown in these examples, the active constraints cannot normally be identified without a system model. This demonstrates the value of whole system modelling: by accounting for the complex relationships among different parts of the system, it can determine the type of the causality in the system and allocate the burdens accordingly. In addition, whole system modelling can indicate places in the system where process improvements can be made and thus aid the environmental system management.

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